ecology and environment, inc.
International Specialists in the Environment

98 Peninsula Street
Wheeling, West Virginia 26003
Tel:(304)231-1176, Fax:(304)231-0920

June 29, 2001

Mr. James Hargett
Site Assessment Manager
United States Environmental Protection Agency
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

RE: Monsanto Old Landfill; Technical Direction Document No. SW3-00-07-0004; Contract No. 68-S3-00-01

Dear Mr. Hargett:

Enclosed please find the draft Preliminary Assessment Report for the Monsanto Old Landfill site located in Nitro, Putnam County, West Virginia. Also enclosed is a draft Fact Sheet for the site.

If you have any questions or comments regarding this document, please contact me at (304) 346-6007.

Sincerely,

Gene Nance
START Site Assessment Group Leader

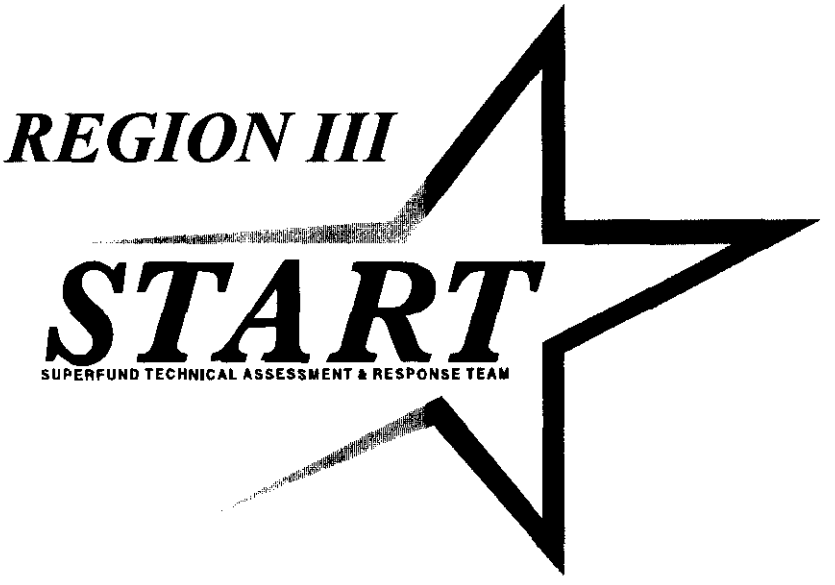
Enclosure

cc: TDD file, E & E, Wheeling, WV

Monsanto Old Landfill (a.k.a. City of Nitro Dump)
Preliminary Assessment Report
Nitro, Putnam County, West Virginia

TDD: SW3-00-07-0004
Contract: 68-S3-00-01
June 2001

Prepared for: James Hargett, Site Assessment Manager
U.S. Environmental Protection Agency



1650 Arch Street
Philadelphia, PA 19103

MONSANTO OLD LANDFILL (a.k.a. CITY OF NITRO DUMP)
PRELIMINARY ASSESSMENT REPORT
NITRO, PUTNAM COUNTY, WEST VIRGINIA

TABLE OF CONTENTS

Section			Page
1.	INTRODUCTION		1-1
2.	SITE BACKGROUND		2-1
	2.1	SITE LOCATION	2-1
	2.2	SITE DESCRIPTION/OWNERSHIP HISTORY	2-1
	2.3	SITE OPERATIONS AND WASTE CHARACTERISTICS	2-2
	2.4	PREVIOUS INVESTIGATIONS AND REGULATORY HISTORY	2-3
	2.5	START ACTIONS	2-6
3.	MIGRATION/EXPOSURE PATHWAYS AND TARGETS		3-1
	3.1	GROUNDWATER MIGRATION PATHWAY	3-1
		3.1.1 *GEOLOGY AND HYDROGEOLOGY*	3-1
		3.1.2 GROUNDWATER RECEPTORS	3-4
	3.2	SURFACE WATER MIGRATION PATHWAY	3-5
		3.2.1 SURFACE WATER PATHWAY CHARACTERISTICS	3-5
		3.2.2 SURFACE WATER USE AND RECEPTORS	3-6
	3.3	SOIL EXPOSURE PATHWAY	3-7
		3.3.1 RESIDENT AND NEARBY POPULATION THREAT	3-7
	3.4	AIR MIGRATION PATHWAY	3-8
		3.4.1 AIR PATHWAY CHARACTERISTICS	3-8
		3.4 AIR RECEPTORS	3-8
4.	CONCLUSIONS		4-1
5.	REFERENCES		5-1

LIST OF TABLES

Table		Page
3-1	Groundwater Drinking Water Population Within a 4-Mile Radius	3-10
3-2	Population and Wetlands Within a 4-Mile Radius	3-11

LIST OF ILLUSTRATIONS

Figure		Page
2-1	Site Location Map	2-7
2-2	Site Sketch	2-8
3-1	4-mile Map	3-12
3-2	15-Mile Surface Water Pathway TDL Map	3-13

ACRONYM LIST

Acronym	Definition
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
DDE	Dichlorodiphenyldichloroethylene
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
HNUS	Halliburton NUS Corporation
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
PA	*Preliminary Assessment*
ppb	parts per billion
PPE	probable point of entry
ppt	parts per trillion
RCRA	Resource Conservation Recovery Act of 1976
RCRIS	Resource Conservation Recovery Act Information System
RFI	RCRA Facility Inspection
SATA	Site Assessment Technical Assistance
START	Superfund Technical Assessment and Response Team
TDL	target distance limit
μg/kg	micrograms per kilogram
WV DNR	West Virginia Department of Natural Resources
WWTP	waste water treatment plant

MONSANTO OLD LANDFILL (a.k.a. CITY OF NITRO DUMP)
PRELIMINARY ASSESSMENT REPORT
NITRO, WEST VIRGINIA

1. INTRODUCTION

Ecology and Environment, Inc., (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of a Preliminary Assessment (PA) at the Monsanto Old Landfill, located in Nitro, Putnam County, West Virginia. E & E completed PA activities under Technical Direction Document No. SW3-00-07-0004, issued under EPA, Region 3, Superfund Technical Assessment and Response Team (START) Contract No. 68-S3-00-01.

The specific goals for the Monsanto Old Landfill PA, identified by the EPA, are to:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

Completion of the PA included reviewing available site information, collecting information on potential receptors within the target distance limits, determining regional geology, groundwater, surface water, and population characteristics, and conducting a site drive by. This document includes a discussion of site background information (Section 2), a discussion of migration/exposure pathways and potential receptors (Section 3), Conclusions (Section 4), and a list of references (Section 5).

(This page intentionally left blank)

2. SITE BACKGROUND

2.1 SITE LOCATION

Site Name:	Monsanto Old Landfill (a.k.a. City of Nitro Dump)
CERCLIS ID No.:	WVSFN0305490
Location:	Kanawha River Mile Point 41.9, 1 Monsanto Road Nitro, West Virginia 25143
Latitude:	38° 26' 40" North
Longitude:	81° 50' 23" West
Site Owner:	Solutia, Incorporated
Site Contact:	Mr. Tony Tuk, Remediation Manager Solutia, Inc. 1 Monsanto Road Nitro, West Virginia 25143 Tel. No. (304) 759-4204

2.2 SITE DESCRIPTION/OWNERSHIP HISTORY

The Monsanto Old Landfill is located on the northern portion of the Flexsys America, L.P. (Flexsys) Plant (formerly known as Monsanto Chemical Company), in Nitro, Putnam County, West Virginia at mile point 41.9 on the right descending bank (RDB) of the Kanawha River. The property is located north of Interstate Highway 64 (I-64) and includes the Flexsys waste water treatment plant (WWTP) and several closed surface impoundments. The precise boundaries of the Monsanto Old Landfill are not well defined, however, it is reported to be situated on an approximately 6-acre area of land in the southwestern portion of the Flexsys WWTP property, extending underneath I-64 to the south of the property. The Monsanto Old Landfill is identified in file documents as the "City of Nitro Dump" and "Nitro Dump" (Frazer,1984a and 1985b). The "City of Nitro Dump" is also identified as a solid

waste management unit (SWMU) in Flexsys/Monsanto's Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. WVD039990965 (Shoemaker, 2001). Other features of the WWTP property include tanks and buildings associated with the WWTP, and seven former surface impoundments which were closed under RCRA jurisdiction in 1987. The former surface impoundments were identified as the digester, activated sludge basin, surge basin, emergency basin, equalization basin, polishing basin, and limestone pit (Park, 1983). The surface impoundments have been closed and four of the impoundments, the emergency, surge, and equalization basins and the limestone pit were closed as hazardous waste units (HNUS, 1993). The WWTP property, on which at least a portion of the Monsanto Old Landfill is located, is bordered on the south side by I-64; on the east side by commercial and industrial businesses; on the north by the City of Nitro WWTP, and on the west side by the Kanawha River (Figures 2-1 and 2-2). Monsanto began operations in Nitro in 1929 when it acquired Rubber Services Laboratories based in Akron, Ohio and Nitro, West Virginia (Frazer, 1984a). The site was owned and operated by Monsanto from 1929 to 1997 when Monsanto underwent a corporate reorganization and all chemical operations were placed under the newly formed company, Solutia Inc., which operates as a Monsanto subsidiary. The facility is currently operated under the name of Flexys America L.P., a joint venture between Solutia and Akzo Nobel, a company based in the Netherlands (Flexsys, 2001 and Charleston Gazette, 2001).

2.3 SITE OPERATIONS AND WASTE CHARACTERISTICS

The Monsanto Old Landfill was an unlined landfill used as a disposal area from 1929 to 1956 and received municipal waste and industrial wastes which may have been associated with the production of herbicides, pesticides, and fertilizers including 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) and 2,4-Dichlorophenoxyacetic acid (2,4-D) (EPA, 1983; Wassersug, 1984). Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) was produced as an unwanted by-product during the production of 2,4,5-T. Production continued until 1969 when the buildings associated with the production of herbicides were decontaminated dismantled, and buried (Frazer, 1984b). The ultimate disposal of the majority of the buildings is unknown, however, an area near the WWTP was used for the disposal of the last production building, however, it was not disposed of in the Old Landfill (HNUS, 1993). According to field trip reports prepared by Halliburton NUS Environmental Corporation (HNUS), plant officials stated that this

area of disposal, which is at a different location than the Old Landfill, measured approximately 20 by 30 yards and consisted of decontaminated blocks and concrete (HNUS, 1993).

2.4 PREVIOUS INVESTIGATIONS AND REGULATORY HISTORY

From June 30 through July 1, 1983, HNUS conducted a dioxin sample screening investigation at the Monsanto plant. Samples were collected from on-site soils in former 2,4,5-T production areas (located in the southern portion of the plant, a monitoring well at the WWTP, and the WWTP outfall to the Kanawha River. Results from soil samples collected from former 2,4,5-T production areas and the area where an incinerator was previously located indicated the presence of 2,3,7,8-TCDD in soils ranging from 0.41 parts per billion (ppb) to 140 ppb. Analytical results for a groundwater sample from the on-site monitoring well indicated the presence of 2,3,7,8-TCDD at 2.0 parts per trillion (ppt). Results for WWTP effluent indicated 2,3,7,8-TCDD at 0.1 ppt (HNUS, 1993).

On August 23, 1983, a geophysical investigation of the WWTP area at the Monsanto plant was conducted by Earth Tech, Inc. The purpose of the investigation was to determine the burial location of the former processing equipment and demolition debris from the former 2,4,5-T production building. The investigation consisted of magnetic profiling, electromagnetic ground conductivity, and ground-probing radar. Results of the survey identified an area west of the treatment plant control building that appeared to be the area of disposal (HNUS, 1993).

From August 29, 1983 through September 28, 1983, HNUS conducted a dioxin extent-of-contamination investigation at the Monsanto plant. The investigation included collection of on-site and off-site soil and sediment samples. HNUS also contracted Geraghty and Miller, Inc. to conduct a geohydrologic investigation, which included drilling 24 soil borings and installing five groundwater monitoring wells in the vicinity of the WWTP. Analytical results for soil samples collected near the WWTP indicated concentrations of 2,3,7,8-TCDD ranging from 0.77 ppb to 110 ppb. Results for sediment samples indicated 2,3,7,8-TCDD concentrations ranging between 0.2 to 18.9 ppb, however, the report did not indicate the location where the samples were collected (HNUS, 1993).

On December 5, 1983, EPA issued Monsanto an Administrative Order on Consent pursuant to §3013 of the RCRA. The Order required Monsanto to conduct monitoring, testing, analyses, and reporting as set forth in the Revised Protocol EPA/Monsanto Sampling Plan inside the Monsanto plant,

the WWTP, and in off site areas near the plant (EPA, 1983). On December 12, 1983, Monsanto submitted an agreement covering additional dioxin sampling at the Nitro plant (Frazer, 1983).

On August 13, 1984 EPA sent Monsanto a letter to request information pertaining to waste disposal at the Nitro Dump and at a facility referred to as the "Monsanto site" (Wassersug, 1984). Monsanto responded in a letter dated September 12, 1984. The Monsanto response included the dates of operation and a map depicting the location of the Nitro Dump in the southwestern portion of the WWTP property.

On September 15, 1984, HNUS conducted a dioxin extent-of-contamination investigation of the Nitro Dump, located on the Monsanto plant property, south of the wastewater treatment plant. The investigation included the collection of hand auger samples from the perimeter and interior of the old fill area. Concentrations of 2,3,7,8-TCDD ranged from 0.06 ppb to 13.5 ppb (HNUS, 1993).

In a letter dated October 1, 1984, Monsanto proposed to the EPA a remedial work plan to be performed at the Monsanto plant. Proposed remedial action outlined in the letter consisted of paving with asphalt the areas where 2,4,5-T was manufactured (located in area of the plant south of I-64), removal of soil from a small contaminated area, covering the area where a trash incinerator was located with crushed limestone, and installing a clay cap over the disposal site of the equipment from the 2,4,5-T production facilities (Frazer, 1984b).

Monsanto submitted a work plan to conduct a Feasibility Study for the Nitro Dump Site to EPA on February 19, 1985 which listed capping the site as a possible alternative for remedial action (Frazer, 1985a). EPA approved the work plan, making minor editorial comments in a letter to Monsanto dated March 15, 1985. Monsanto submitted the Final Feasibility Study for the City of Nitro Dump Site on March 27, 1985 which recommended capping two areas where sampling results indicated the existence of contamination. The proposed cap would consist of a 6-inch layer of compacted clay overlain with a 6-inch layer of topsoil and revegetation (Frazer, 1985b).

On June 27, 1985, a Consent Agreement and Order pursuant to CERCLA (42 U.S.C. § 9601, *et seq.)* was signed by Monsanto and the EPA that identified remedial actions Monsanto was to take as outlined in the approved Feasibility Study (EPA, 1985).

A memorandum dated May 1, 1986, from the Chief of the EPA Region III Hazardous Waste Enforcement Branch Bruce P. Smith to Stephen R. Wassersug, the EPA Region III Director of the Hazardous Waste Management Division, indicated that Monsanto had submitted documentation

certifying that remedial action (capping) had been completed at the facility formerly known as the Nitro Dump. Mr. Smith had inspected the work on March 4, 1986 and found that the required actions had been accomplished in a professional manner and in accordance with the Consent Agreement and Order. The installed cap did not and was not required to meet RCRA standards. He recommended that the certification should be approved (Smith, 1986).

On June 5, 1986, Monsanto submitted a closure plan for the plant's RCRA hazardous waste emergency, surge, and equalization basins and the limestone bed associated with the site's wastewater treatment plant to the WVDNR, which approved the plan. The closure activities were completed in November 1986 (HNUS, 1993). EPA Resource Conservation and Recovery Act Information System (RCRIS) database information indicates that three hazardous waste surface impoundments were closed on March 19, 1987. One of the surface impoundments is listed as obtaining "clean closure" status, which would not require long-term post-closure care and monitoring. The other two impoundments are assigned a status of "closed with waste in place", which indicates that long-term RCRA post-closure care and monitoring would be required (EPA, 2001).

On August 23, 1988, during a compliance evaluation conducted by WVDNR, groundwater was collected from monitoring wells located adjacent to the WWTP. Compounds detected included chloroform, 1,2-dichloroethane, 1,2-dichloropropane, trichloroethene (TCE), chlorobenzene, benzene, toluene, ethylbenzene, xylene, vinyl chloride, and 1,1,2,2-tetrachloroethane (HNUS, 1993).

Roy F. Weston, Inc. (WESTON), EPA Site Assessment Technical Assistance (SATA) team collected sediment samples from the Kanawha River in November 1998. A sample collected near the Monsanto Old Landfill at Mile Point 41.8 of the Kanawha River had dioxin toxicity equivalence (TEQ) of 1,648.20 ppt (WESTON, 1999a).

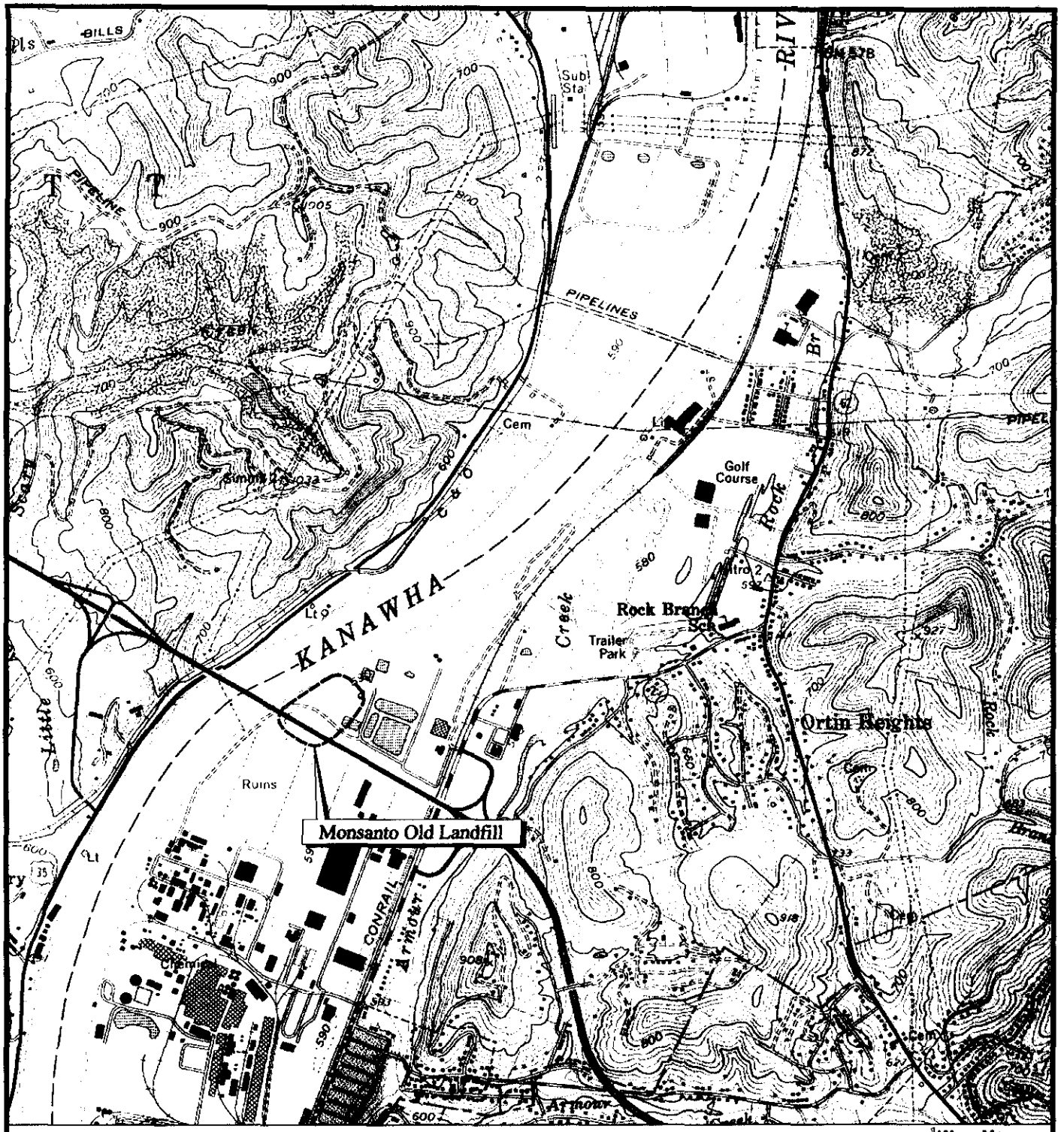
On May 13, 1999, the WESTON SATA team conducted a sampling assessment of the Monsanto Old Landfill area including migration pathways to the Kanawha River. The objective of this study was to determine the presence and concentrations of dioxin and the potential for migration to the Kanawha River (WESTON, 1999b).

On June 16, 1999, the EPA and SATA collected additional samples including two soil samples at the base of the earthen I-64 ramp to the bridge over the Kanawha River; one from the northern ditch line; the other from the southern ditch line. Analytical results for samples D-70 and D-71 indicated 2,3,7,8-TCDD concentrations of 865 ppt and 274 ppt, respectively (WESTON, 1999b).

Monsanto has a RCRA Corrective Action permit through EPA which requires the company to conduct a plant-wide investigation of former SWMUs, including the City of Nitro Dump (Monsanto Old Landfill). Monsanto has completed the RCRA Facility Inspection (RFI) and has completed work towards interim measures stabilization to address groundwater contamination at the landfill. A groundwater monitoring system is in place and *in situ* biosparging of the groundwater is being conducted. Monsanto is currently conducting the RCRA Corrective Measures Study (CMS) with the goal of determining final remediation and long-term requirements for the entire plant (Shoemaker, 2001).

2.5 START ACTIONS

On May 21, 2001, START member Gene Nance conducted an off-site reconnaissance. Written access had not been obtained to enter the site, therefore, an on-site inspection was not conducted. START documented site features, drainage pathways, and surrounding area use in order to evaluate the pathways for the site.



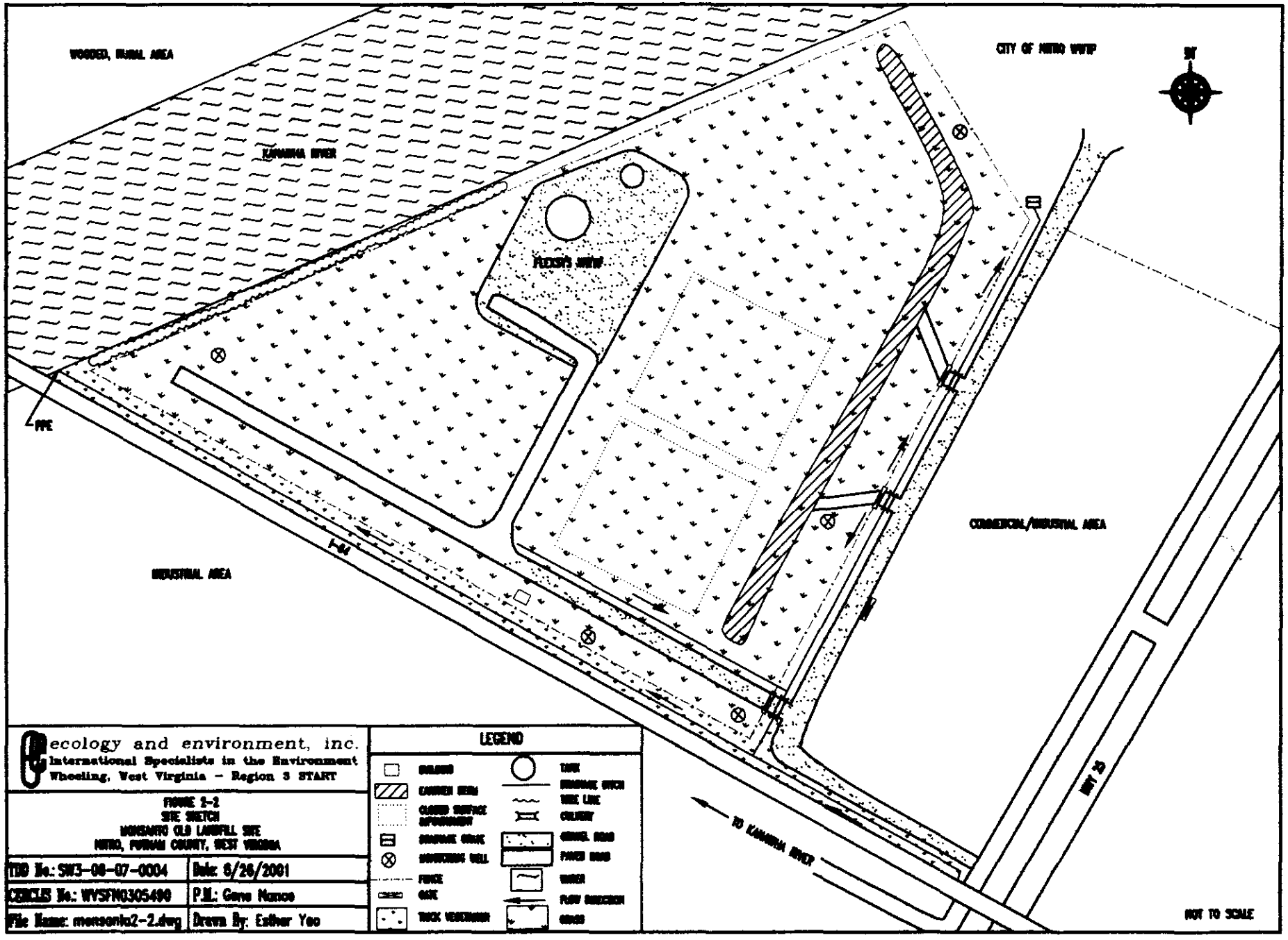
Source: USGS 1976.

	CERCLIS No.: WVSFN 0305490	TDD No.: SW3-00-07-004

ecology and environment, inc.
International Specialists in the Environment
Wheeling, West Virginia - Region 3 START

FIGURE 2-1
SITE LOCATION MAP
MONSANTO OLD LANDFILL
NITRO, PUTNAM COUNTY, WEST VIRGINIA

File Name: fig 2-1.cdr	Created by: AES	Date: 5/25/01



ecology and environment, inc.
International Specialists in the Environment
Wheeling, West Virginia – Region 3 START

FIGURE 2-2
SITE SKETCH
MONSANTO OLD LANDFILL SITE
NITRO, PUTNAM COUNTY, WEST VIRGINIA

TDD No.: SW3-08-07-0004	Date: 8/26/2001
CERCLIS No.: WVSFN0305490	P.M.: Gene Nance
File Name: monsanto2-2.dwg	Drawn By: Esther Yeo

3. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

3.1 GROUNDWATER PATHWAY

3.1.1 Geology and Hydrogeology

The Monsanto Old Landfill site is located in the Appalachian Plateaus Physiographic Province (Schwietering, 1981). Geologic units in the area include the following, from most recent to oldest:

- Quaternary System (Pleistocene and Recent-Age) Alluvium;
- Permian System - Dunkard Group Formations;
- Pennsylvanian System - Monongahela Group, Conemaugh Group, Allegheny Group, and *Pottsville Group Formations; and*
- Mississippian System - Mauch Chunk Group, Greenbriar Group, Maccrady, and Pocono Formations (Schwietering, 1981; Wilmoth, 1966).

The rocks of Pennsylvanian age that are exposed in Putnam and Mason Counties are gently folded with dips ranging from approximately 5 to 145 feet per mile. The predominant structural feature is the Parkersburg syncline, the axis of which trends northeastward, passing near the common boundary between Putnam and Mason Counties. Rock outcropping in the Nitro area generally consists of red and gray shale, gray siltstone and sandstone, thin marine and fresh water limestone, and coal or dark-gray silty shale with plant fossils of the Pennsylvanian-age Conemaugh Group (Schwietering, 1981; Cardwell and Erwin, 1968; and Fonner, 1987). The hilltops near the site consist of rocks of the Pennsylvanian-age Monongahela Group (Schwietering, 1981; Cardwell and Erwin, 1968; and Fonner, 1987). The site is situated in the Kanawha Valley flood plain, with soils consisting of alluvial sediments overlain with lacustrine sediments deposited in the Pleistocene Age when the Ancient Teays River was blocked by glaciers, creating a large lake in the Teays Valley (Fonner, 1987). Sediment thickness in the Kanawha River Valley in Putnam and Mason Counties averages 58 feet, with the thickest observed at 70 feet (Wilmoth, 1966). The sediments in the vicinity of the site typically consist of a 10- to 20-feet thick silty-clay or clay layer at the surface underlain by sand, grading from fine to medium to coarse with gravel to

a depth of approximately 60 feet below ground surface (bgs). Bedrock is normally encountered at approximately 60 feet bgs and consists of formations of the Conemaugh Group (Wilmoth, 1966). The Conemaugh Group consists of a variety of lithologies. A generalized section of the Conemaugh Group is as follows (Wilmoth, 1966):

	Thickness (feet)
shale, red	4
sandstone, Lower Pittsburgh	45
shale, red and green	30
limestone, Pittsburgh	1
coal, Little Pittsburgh	3
clay, Little Pittsburgh (fire clay)	1
sandstone, Connellsville	*40*
shale, red and green	30
shale, sandy	2
shale, limy and limestone, Clarksburg	3
sandstone, Morgantown	30
shale, red and green	3
shale, black, and coal, Elk Lick	1
limestone, Elk lick	5
sandstone, Grafton	45
shale, Birmingham	10
shale, limy, Upper Ames	16
sandstone	2
limestone, Lower Ames	2
shale, red, Pittsburgh	15
sandstone, Saltsburg	13
shale, red	5
shale, limy, Pine Creek	5

shale (maximum depth of exposure in Putnam and Mason Counties)	15
sandstone, Buffalo	60
shale	15
coal, Brush Creek	3
sandstone, Mahoning	80
Total thickness	484

The shallow aquifer under the site is in the Alluvium, which consists of unconsolidated deposits of clay, silt, sand, and gravel, with an average thickness of 50 to 60 feet bgs. The gravel and sand lenses constitute the principal aquifers in the alluvium. The average thickness of saturated deposits is approximately 42 feet The alluvial aquifer is hydraulically connected with the Kanawha River with discharge to the river by bank and stream-bed seepage (Wilmoth, 1966). The shallow alluvium is or has formerly been used as a source for moderate industrial use and for municipal and rural drinking water supplies. Yields of wells completed in the alluvium in the Kanawha Valley range between 10 to 200 gallons per minute (GPM) and average approximately 70 GPM (Schwietering, 1981; Wilmoth, 1966). Induced flow from the Kanawha River may occur in wells drilled near the river. Wells formerly operated as a source for cooling water at a nearby industrial facility (Ohio Apex, which sold the facility to FMC Corporation in 1952) were screened in the alluvial aquifer at depths ranging from approximately 40 to 60 feet bgs, with the majority screened between 50 to 60 feet bgs. The yield of these wells ranged from 75 to 150 gallons-per-minute. The majority of those wells were abandoned prior to 1954 (most in the 1930s and 1940s) when the yields dropped below 35 GPM (Fonner, 1987). The water in the alluvium is generally of the sodium bicarbonate type; however, in places the principal cation may be calcium or magnesium and the principal anion may be sulfate. Iron content ranges from low to very high and the pH is usually acidic, with pH varying between 5.5 to 6.0 in former wells near the Monsanto Old Landfill site site, however, in some areas the water may be alkaline (Wilmoth, 1966). Additional site-specific geology and groundwater information is available in the EPA RCRA files. The site is currently being investigated under RCRA Corrective Action Program. Compounds detected in monitoring wells include

chloroform, 1,2-dichloroethane, 1,2-dichloropropane, trichloroethene (TCE), chlorobenzene, benzene, toluene, ethylbenzene, xylene, vinyl chloride, and 1,1,2,2-tetrachloroethane (HNUS, 1993).

Groundwater occurs in the Conemaugh Group in joint openings, in partings along bedding planes, and in the intergranular pore spaces. Due to the small average size of the joint openings and partings, most of the water storage capacity would be available in the intergranular pores. Water-bearing joint openings and bedding plane partings are better developed in sandstone than shale and siltstone and sandstone generally transmits water more readily than the fine-grained rocks. Results of aquifer tests in the Pennsylvanian-age rocks which were overlain by alluvial deposits near the Kanawha River commonly displayed some indication of hydraulic connection between the bedrock and the alluvium and/or the river. Drilled wells in these formations in Putnam and Mason Counties varied in depth between 24 and 360 feet bgs, averaging 146 feet bgs. Dug wells ranged in depth between 10 and 80 feet bgs and averaged 23 feet bgs. Reported well yields ranged from less than 1 to 102 GPM and averaged approximately 9 GPM (Wilmoth, 1966). Wells were installed in the Conemaugh Group formations at the Monsanto Plant at depths of 200 to 275 feet bgs and had yields of 25 to 50 GPM. These wells were all abandoned by 1944 (Wilmoth, 1966). Water quality in the bedrock formations varies considerably due to the diversity of rock types. The groundwater in the rock formations may vary from slightly acidic to moderately alkaline. The iron content and hardness are moderate to high, with water from the bedrock formations being generally harder than water from the alluvium (Schwietering, 1981).

The annual net precipitation for the area is 16.9 inches as measured at Charleston, West Virginia, located approximately 17 miles east of Nitro (Mitre Corporation, 1988).

3.1.2 Groundwater Receptors

The City of Nitro and surrounding rural areas obtain drinking water primarily from West Virginia American Water Company, which obtains its water through a surface water intake located on the Elk River in Charleston, West Virginia (Gillispie, 2001; Perkins, 2001). There are no public supply water wells located within a 4-mile radius of the site (Gillispie, 2001). Limited information is available on specific domestic wells and their usage in the area. The nearest identified drinking water well is a domestic well located approximately 3 miles northeast of the site (Holston, 2001; Westfall, 2001). Table 3-1 provides the population within a 4-mile radius of the site that uses groundwater as a source of

drinking water based on 1990 U.S. Census data (Frost Associates, 2001). This information indicates the existence of approximately 275 private drinking water wells within a 4-mile radius of the site. However, public water supply pipelines have been extended into the rural areas in the vicinity of the site since the 1990 census, and these numbers may not accurately reflect the current number of private drinking water wells that are in use. The groundwater may also be used for agricultural, industrial, and commercial supply (Wilmoth, 1966).

There are no wellhead protection areas within a 4-mile radius of the site (Gillispie, 2001).

3.2 SURFACE WATER PATHWAY

3.2.1 Surface Water Pathway Characteristics

The topography of the site includes gently rolling terrain with higher elevations in areas of the closed surface impoundments. A grass-covered earthen berm was observed along the northern and eastern portions of the site, between the closed impoundments and the fence line. Water runoff from the southeastern portion of the site drains to a ditch that parallels the gravel road that extends from the access gate located at the southeastern corner of the site to the paved road which extends into the Flexsys WWTP. This ditch drains off site into a ditch which parallels the fence line along the southeastern boundary of the site, crossing under the access road through a culvert and extending for approximately 50 feet, where it drains into another ditch, which extends approximately 1,800 feet in a northwesterly direction to the probable point of entry (PPE) into the Kanawha River (Fig. 2-2). The entire 15-mile TDL is located in the Kanawha River. The ditch along the northern portion of the eastern site perimeter drains in a northeasterly direction into a grate located between the site and the City of Nitro WWTP. Since START did not have access to go on site, other drainage and containment features could not be verified, however, Flexsys has an National Pollutant Discharge Elimination System (NPDES)-permitted outfall for the WWTP and runoff from the areas where prior remediation has been completed drains to the WWTP; therefore it may be presumed that runoff from most areas of the property is contained and directed to the an NPDES outfall into the Kanawha River. The Old Landfill is presumed to be located in the southwestern portion of the site (Figure 2-2). This area is relatively flat and the location of the Old Landfill is not obvious based on terrain.

The area encompassed by the Old Landfill may be contained and discharged through an NPDES stormwater outfall.

Gaging station No. 03198000 is located in Charleston, West Virginia, approximately 13 miles upstream of the Monsanto Old Landfill site. Based on historic stream flow records at this station, the Kanawha River is classified as a large river, with a mean flow rate of 15,130 cubic feet per second (cfs) based on data from 1941 to 2000, with the highest annual mean flow rate of 20,960 cfs in 1973 and the lowest annual mean of 8,649 cfs in 1988 (Ward, *et al,* 2001).

The 2-year, 24-hour maximum rainfall for the area is approximately 2.75 inches (Hershfield, 1961). The site is not located within the 100-year flood zone (FEMA, 1993 and 1987)

Soils at the site are classified as Urban land-Lindside complex (Un) and Udorthents, smoothed (UD) (Cole, *et al,* 1985). The Un complex consists of areas covered by urban structures like asphalt, concrete, or other impervious materials and areas of moderately well drained Lindside silt loam. The available water capacity of the Lindside soil is high. Permeability is moderate or moderately slow in the subsoil. Runoff is slow or medium, and natural fertility is high (Cole, *et al,* 1985). The UD unit is defined as being nearly level to very steep, mixed soil material and rock fragments from areas which have been disturbed by excavation, fills, and gradings. This soil is prevalent along I-64 and other state highways. Along the Kanawha River, these soils are dark brown, dark yellowish brown, gray, and black sandy loam, loam, or silt loam, with coarse fragments of gravel in some areas. The fill areas may range from 1 foot to more than 30 feet deep. This unit as mapped may contain a few small areas of the well drained Gilpin, Lily, Upshur, Huntington, Kanawha, Allegheny, and Ashton soils and the moderately well drained Lindside, Monongahela, and Vincent soils. These inclusions make up approximately 10 per cent of the soil unit. This soil unit generally has a very low to high available water capacity and permeability and runoff is slow to very rapid (Cole, *et al,* 1985).

3.2.2 Surface Water Use and Receptors

The Monsanto Old Landfill site is located in the Kanawha River basin. The Kanawha River watershed is divided into upper and lower sections, or hydrologic unit (HUCs). The lower section, HUC No. 0505008, includes the main stem of the Kanawha River downstream from its confluence with the Elk River in Charleston, West Virginia, and all tributaries of the section, excluding the Coal River (Ward, *et al,* 2001)

There are no drinking water intakes located within the 15-mile downstream TDL, which extends to near Fraziers Bottom, West Virginia (Figure 3-2) (Gillispie, 2001). The residents of the area surrounding the Monsanto Old Landfill site and most other downstream communities along the Kanawha River obtain drinking water from West Virginia American Water Company, which obtains its water from intakes on the Elk River in Charleston (Gillispie, 2001); Perkins, 2001). Some area residents obtain drinking water from private wells (Holston, 2001; Westfall, 2001).

The Kanawha River is used for recreational fishing in the vicinity of the site (WV DNR, 2001). Species identified in the 2000 Lock Chamber Survey conducted by the West Virginia Division of Natural Resources at the U.S. Army Corps of Engineer's Winfield Locks include: bluegill, channel catfish, flathead catfish, freshwater drum, hybrid striped bass, longear sunfish, sauger, spotted bass, striped bass, walleye, white bass, white crappie, common carp, gizzard shad, longnose gar, skipjack herring, black buffalo, quilback carpsucker, river carpsucker, shorthead redhorse, silver redhorse, smallmouth buffalo, and spotted sucker. The data obtained in the survey indicated the presence of 527 fish weighing a total of 1,358 pounds in the Winfield locks, representing a fish population density of 1,146 fish per acre and 2,952 pounds per acre in the locks (Preston, 2001). Records pertaining to the quantity of fish caught from the river and human consumption data are not available. A fish consumption advisory due to dioxin contamination is in effect in West Virginia for this area and is delineated as the Kanawha River and backwaters from the I-64 bridge in Dunbar, West Virginia to the Ohio River. The advisory recommends that the following species should not be eaten: carp; catfish; suckers; and hybrid striped bass. The advisory also recommends that consumption of all other species be limited to one meal per month (WV DHHR, 2001).

There are no threatened or endangered species or critical habitats located within the 15-mile TDL (Sargent, 2001). There are no state or federal parks, wildlife refuges, scenic streams, or wildlife management areas within the 15-mile TDL (USGS, 1958). There are no HRS-qualified wetlands within the 15-mile TDL (US DOI, 1990).

3.3 SOIL EXPOSURE PATHWAY

3.3.1 Resident and Nearby Population Threat

The Monsanto Old Landfill site is located along the eastern bank of the Kanawha River, approximately 200 feet north of the I-64. The site is bounded to the northeast by the City of Nitro

POTW, to the northwest by the Kanawha River, to the southwest by I-64, and to the southeast by commercial/industrial businesses (Figures 2-1 and 2-2).

The Flexsys WWTP is situated on the site property and includes several tanks and buildings. It is unknown how many Flexsys employees work at the site.

There are no commercial agriculture, silviculture, or livestock production/grazing activities on any of the surrounding properties. There are no schools or daycare centers located on site or within 200 feet of the site. The nearest residents are located approximately 2,000 feet east of the site. There are no known terrestrial sensitive environments or wetlands located on the site (US DOI 1990).

Access to the site is restricted by a 6-feet high chain link fence with barbed wire at the top that encompasses the site. There are three locked gates along the southeastern facility fence line.

The area of potentially contaminated soil is estimated to be approximately 6 acres, which includes the area presumed area of the Old Landfill and adjacent areas.

There are no residents within 200 feet of the site. The population within the 1-mile travel distance of the Monsanto Old Landfill site is approximately 378 which includes 120 residents and 258 students and staff members at Rock Branch Elementary School (Frost Associates, 2001; France, 2001). There are no known daycare centers within the 1-mile TDL. The population data is summarized in Table 3-2.

3.4 AIR MIGRATION PATHWAY

3.4.1 Air Pathway Characteristics

The site is predominantly covered with grass/vegetation. The remaining portions of the Monsanto Old Landfill site are covered with buildings and areas of concrete, asphalt, and some gravel-covered roads. The man-made and natural cover would limit the potential for release of particulate material and gases to the air and the landfill is reported to have installed a new cap in the late 1980s as part of a Consent decree (Smith, 1986).

3.4.2 Air Receptors

The area within the 4-mile radius TDL includes rural, commercial, industrial, and residential properties (Ref. Quad). The population residing within the 4-mile radius TDL is summarized in Table 3-2 The nearest individual residents are located approximately 2,000 feet to the east of the site.

No commercial agriculture or silviculture were observed within a 0.5 mile radius of the site.

There are no threatened or endangered species or critical habitats within the 4-mile radius TDL (Sargent, 2001). There are no state or federal parks, wildlife refuges, scenic streams, or wildlife management areas within the 4-mile TDL.

The National Wetlands Inventory maps indicate the presence of approximately 110 acres of HRS-eligible wetlands within the 4-mile radius TDL (US DOI, 1990). The wetland areas are summarized by distance rings in Table 3-2.

Table 3-1

GROUNDWATER DRINKING WATER POPULATION WITHIN A 4-MILE RADIUS

Distance (Miles)	Wells*	Population
0 - 0.25	0	0
0.25 - 0.5	3	7
0.5 - 1	10	28
1 - 2	47	124
2 - 3	90	224
3 - 4	125	311
Total	**275**	**694**

Source: Frost Associates Report based on 1990 census data.

Table 3-2

POPULATION AND WETLANDS WITHIN A 4-MILE RADIUS

Distance Ring (Miles)	Population*	Wetlands (Acreage)
On site	Unknown**	0
0 - 0.25	2	0
0.25 - 0.5	23	0
0.5 - 1	90	13
1 - 2	334	8
2 - 3	470	9.5
3 - 4	634	79
Total	**1553**	**110**

* Unknown number of Flexsys workers on site.

** Frost associate data.

(*This page intentionally left blank*)

Source: USGS 1984.

	CERCLIS No.: WVSFN 0305490	TDD No.: SW3-00-07-004
ecology and environment, inc. International Specialists in the Environment Wheeling, West Virginia - Region 3 START	FIGURE 3-2 15-MILE SURFACE WATER PATHWAY TDL MAP MONSANTO OLD LANDFILL NITRO, PUTNAM COUNTY, WEST VIRGINIA	
File Name: fig 3-2.cdr	Created by: AES	Date: 5/30/01

4. CONCLUSIONS

The Monsanto Old Landfill has had a significant number of investigations conducted which have identified areas of contamination and resulted in the capping of some areas. The full extent of the landfill has not been determined, but approximately two thirds of the landfill may be underneath an approximately 20-feet thick fill layer which was constructed to provide a ramp for the I-64 bridge over the Kanawha River. The site has an ongoing Corrective Measure Study under EPA RCRA Corrective Action. A groundwater monitoring system in place which is being monitored, however, the wells are not currently being monitored for dioxin.

(This page intentionally left blank)

5. REFERENCE LIST

Cardwell, D.H., Erwin, R.B., and Woodward, H.P, 1968, *Geologic Map of West Virginia.* West Virginia Geological and Economic Survey, Morgantown, West Virginia

Cole, C. P., *et al,* 1985, *Soil Survey of Putnam County, West Virginia,* U.S. Department of Agriculture Soil Conservation Service, Washington, D.C.

Federal Emergency Management Agency (FEMA), 1993 and 1987, Flood Insurance Rate Maps, Putnam County, West Virginia Unincorporated Areas, October 15, 1993 and June 18, 1987,, Panel Nos. 90 of 145 and 115 of 145.

Flexsys, 2001, company home page, http://www.flexsys.com/internet/pages/who_we_are..htm., January 25, 2001.

Fonner, R.F., 1987, *Geology Along I-64 Putnam County, West Virginia,* West Virginia Geological and Economic Survey, Morgantown, West Virginia.

France, C., 2001, record of communication, Rock Branch Elementary School staff, telephone conversation with G. Nance, E & E, Charleston, West Virginia, April 10, 2001.

Frazer, D. S., 1983, Plant Manager, Monsanto Polymer Products Company, Nitro, West Virginia, letter to Dr. Walter Lee, United States Environmental Protection Agency, Region III, covering additional dioxin sampling at the Monsanto Nitro Plant, December 12, 1983.

_____, 1984a, Plant Manager, Monsanto Polymer Products Company, Nitro, West Virginia, letter regarding information requested by EPA concerning Nitro Dump and Monsanto Present Landfill to Mr. Stephen R. Wassersug, United States Environmental Protection Agency, Region III, September 12, 1984.

_____, 1984b, Plant Manager, Monsanto Polymer Products Company, Nitro, West Virginia, letter and copy of proposed TCDD remedial work to be performed at Nitro plant to Dr. Walter Lee, United States Environmental Protection Agency, Region III, October 1, 1984.

_____, 1985a, Plant Manager, Monsanto Polymer Products Company, Nitro, West Virginia, letter to Dr. Walter Lee, United States Environmental Protection Agency, Region III, outlining the Feasibility Study of the Nitro Dump Site, February 19, 1985.

_____, 1985b, Plant Manager, Monsanto Polymer Products Company, Nitro, West Virginia, letter to Dr. Walter Lee, United States Environmental Protection Agency, Region III, submitting the Final Feasibility Study of the Nitro Dump Site, March 27, 1985.

Frost Associates, 2001, Centracts Report on 1990 U.S. Census Population and Water Supply Data, Clinton, Connecticut, February 2001.

Gillispie, R., 2001, Record of Communication, West Virginia Bureau for Public Health, Office of Environmental Health Services, conversation with G. Nance, E & E, Charleston, West Virginia, January 18, 2001.

Halliburton NUS (HNUS) Environmental Corporation, 1993, Final Site Inspection Prioritization, Monsanto Chemical, EPA Work Assignment No. 37-38-3JZZ, Project No. 3738-39, EPA DSN WV-029, Facility ID No. WVD039990965, ARCS III Program, EPA Contract No. 68-W8-0037, January, 1993.

Hershfield, D.M., 1961, *RAINFALL FREQUENCY ATLAS OF THE UNITED STATES for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years,* Technical Paper No. 40, U.S. Department of Commerce, Washington, D.C.

Holston, R.L., 2001, Record of Communication, Private Well Owner, telephone conversation with G. Nance, E & E, Charleston, West Virginia, February 26, 2001.

The Mitre Corporation, 1988, Draft Revised HRS Net Precipitation Values, McLean, Virginia, May, 1988.

Monsanto, 2001, company history query, http://www.monsanto.com/monsanto/people/work_life/legacy/index2.html, January 25, 2001.

Park, P.S., 1983, Environmental Counsel, Monsanto Company, letter to Mr. James Heenehan, Attorney, Office of Regional Counsel, United States Environmental Protection Agency, Region III, providing a plant map with sampling locations, July, 26, 1983.

Perkins, H., 2001, Record of Communication, West Virginia American Water Co., telephone conversation with G. Nance, E & E, Charleston, West Virginia, February 26, 2001.

Preston, Bret A., Letter, West Virginia Division of Natural Resources Wildlife Resources Section, Letter and 2000 Lock and Dam Chamber Surveys correspondence to Y. Burhan, E & E, February 5, 2001.

Roy F. WESTON, 1999a, Trip Report for sampling mission to assess dioxin contamination along the Kanawha River Valley, Putnam County, West Virginia, Contract No. 68-S5-3002, TDD No. 9901-04, prepared for United States Environmental Protection Agency, Region III, April 14, 1999.

_____, 1999b, Trip Report for sampling assessment of Old Monsanto Landfill, Nitro, Putnam County, West Virginia, Contract No. 68-S5-3002, TDD No. 9906-14, prepared for United States Environmental Protection Agency, Region III, November 22, 1999.

Sargent, Barbara, Letter, West Virginia Department of Natural Resources Wildlife Resources Section, Letter correspondence to Y. Burhan, E & E, January 19, 2001.

Schwietering, J.F., 1981, *Brief Description of Ground Water Conditions and Aquifers in West Virginia*, West Virginia Geological and Economic Survey, Morgantown, West Virginia.

Shoemaker, Jennifer, 2001, record of communication, EPA Region III RCRA Branch, telephone conversation with G. Nance, E & E, Charleston, West Virginia, February 9, 2001.

Smith, Bruce P., 1986, Chief, Hazardous Waste Enforcement Branch, United States Environmental Protection Agency, Region III, memorandum to Stephen R. Wassersug, Director, Hazardous Waste Management Division, EPA Region III, recommending approval of remedial actions (capping) taken by Monsanto at the Nitro Dump, May 1, 1986.

The Charleston Gazette Online, 2001, newspaper homepage, http://www.wvgazette.com/news/News/1999090540, January 25, 2001.

U. S. Department of the Interior (US DOI), National Wetlands Inventory Maps of West Virginia: Saint Albans Quadrangle, 1990; Bancroft, 1990; Scott Depot, 1990; Garretts Bend, 1990; Winfield, 1990; Mount Olive, 1990; and Alum Creek 1990.

_____, 2001, Record of Communication, Columbia Gas Transmission Corporation, telephone conversation with G. Nance, E & E, Charleston, West Virginia, April 10, 2001.

United States Environmental Protection Agency (EPA), Region III, 1983, Administrative Order on Consent in accordance with § RCRA, 42 U.S.C. § 6934 for conducting investigation at Monsanto Chemical Company Plant, Nitro West Virginia, December 1, 1983.

_____, 1985, Consent Agreement and Order to implement Remedial Work Plan, In the Matter of: Monsanto Plant Site, Nitro, West Virginia, Monsanto Company Respondent, Docket No. III-85-17-DC, June 27, 1985.

_____, 2001, Envirofacts RCRIS Query Results, http://oaspub.epa.gov/enviro/fii_master.fii_retrieve, February 16, 2001.

United States Geological Survey (USGS), 7.5 minute topographic maps of West Virginia: Saint Albans Quadrangle, 1958, photorevised 1971 and 1976; Bancroft Quadrangle, 1999; Scott Depot Quadrangle, 1958, photorevised 1989; Garretts Bend Quadrangle, 1958, photorevised 1971 and 1978; Winfield Quadrangle, 1958, photorevised 1989; Mount Olive Quadrangle, 1958, photorevised 1975; and Alum Creek Quadrangle, 1958, photorevised 1971.

Ward, S.M. *et al.*, 2001, *Water Resources Data West Virginia Water Year 2000*, Water Data Report WV-00-1, United States Geological Survey, Charleston, West Virginia.

Wassersug, S. R., 1984, Director, Hazardous Waste Management Division, EPA Region III, letter to Mr. Max Galloway, Monsanto Polymer Products, requesting information regarding the Monsanto site and Nitro Dump, August 13, 1984.

West Virginia Division of Health and Human Resources (WV DHHR), 2001, Fish Consumption Advisory Webpage, Press Release on November 16, 2000, http://www.wvdhhr.org/bph/press/fishadvis.htm, January 19, 2001.

West Virginia Division of Natural Resources WV DNR), Favorite Fishing Waters Webpage, http://www.dnr.state.wv.us/wvfishing/waters.htm., April 13, 2001.

Westfall, F., 2001, Record of Communication, Private Well Owner, telephone conversation with G. Nance, E & E, Charleston, West Virginia, February 26, 2001.

Wilmoth, B.W., 1966, *Ground Water in Mason and Putnam Counties West Virginia*, Bulletin 32, West Virginia Geological and Economic Survey, Morgantown, West Virginia.